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*An Account of some Experiments made at several Meetings of the Royal Society by the Ingenious Fred. Slare M. D. Fellow of the Royal Society, and one of the Colledge of Physicians, with some short applications of them to Physical matters.*

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## Experiment I.

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*A Parallel betwixt Lightning and a Phosphorus.*

1. **I**N order to the keeping my *solid Phosphorus* from consuming, I usually plac'd it at the bottom of a Glass of *Water*: having several of these Glasses disposed upon a Table in view whilst I lay upon my Bed, I could observe several *flashes of Light* that successively pass through the *Water*, and made such bright and vigorous *Coruscations* in the Air, as would surprize and affrighten one not used to the *Phænomenon*. This fiery *Meteor* passes something contracted through the incumbent *Water*, but expands itself much as soon as it gets above it. If you would make these *Experiments* to advantage, the Glass ought to be deep and Cylindrical, and not above Three-quarters fill'd with water.

If.

If we compare these appearances with *Lightning*, we may observe that *Lightning*, which comes at *Intervalls* passes uninterrupted the most condensed *Clouds*, and is not extinguished or obstructed by the greatest Storms or *Cataracts* of water, but like the Beams of the Sun or any other fire freely passes through *Glass* and water.

2. This *Phosphorus* in the mentioned state only emits these *Flashes* of *Light* in warm weather, a certain temper of the *Air* being necessary to produce the effect, for in the *Winter* or cold weather I never observed it.

The warm season of the *Summer* is most productive of of *Lightning*.

3. The mention'd *Flash* of *Light* is not apt to kindle or burn any combustible matter, as I found by holding my finger in it unmolested, but not trusting to that, I held in the flame, *Paper*, *Flax*, and such Materials as are apt to take fire, which it did no more than when we projected the *Light* of the *Moon* by a *Concave Glass*, upon the like bodies.

Such an inoffensive *Flame* that of *Lightning* is generally observed to be. But

4. The matter of the *Phosphorus*, whilst in a more condensed body, will easily be accended by the warmth of the *Air*, or by the immediate *Beams* of the *Sun*, and then will burn very furiously with such a penetrating fire as will not easily be extinguished.

Thus *Lightning*; when condensed or contracted, and wrapt up in a *Vehicle* of *Air*, so that it does not so easily diffuse itself through the yielding *Aether*; will then set fire to *Houses*, *Trees*, &c., and do great mischief.

5. Our matter whilst burning acts the part of *Corrosive*, and when it goes out it resolves into a *Menstruum* that dissolves *Gold*, *Iron*, and other *Metals*.

Thus *Lightning* melts down, *Gold*, *Iron*, *Lead*, and other *Metals*.

These *Experiments* were concluded most Naturally to illustrate

illustrate and resemble the *Phænomena* of *Lightning*, far exceeding either those made with *Nitre*, *Gun-powder* or *Aurum fulminans*. As to some other properties of this shining and burning *Preparation* see the *Philosophical Collections*.

### *Experiment II.*

**BY** mixing Two *Liquors* actually cold to produce such sparkling and fiery bodies, as are not only visible in the dark, but at noon day in the enlightened Air.

This *Experiment* was not a little surprizing, which was thus made. We took betwixt Ten and Twenty Grains of the *Solid Phosphorus* and caused it to melt in as much water as would just cover it, which was about a Dram: after it was actually cold we poured it into two Ounces of *Oyl* of *Vitriol*, which being well shaken together did first heat, and then throw up such fiery *Balls*, which like so many Stars will adhere to the sides of the *Glass* and continue to burn for some time to the great pleasure of the *Spectator*.

### *Experiment III.*

**BY** the addition of an *Oyl* to the foregoing mixture to produce a flame.

This is done only by pouring a small quantity of *Oyl* of *Turpentine*, without shaking the Vessel, the mixture takes fire and burns very furiously. This *Experiment* ought to be made in an open Vessel where the *Air* has a free access. This succeeded with *Oyl* of *Petroleum*, and *de Lateribus*: but *Sallet-oil* and spirit of *Wine* would not be made to flame.

The Ingredients that compose this burning mixture are apart cold to the touch, and some of them in their O-

perations, thus *Water* and *Oyl* of *Vitriol* are cooling in their *Nature*, but these in *Conjunction* cause a great *heat*, which soon excite the agile Particles of our *Phosphorus* to an actual fire, and this Meeting with an inflammable Ingredient such as *Oyl* of *Turpentine*, or the like; does produce as considerable a *flame* as boiling *Oyles* as wont to do.

These *Experiments* would have been less considerable or surprizing, had that of *Borrichius* been certain (mention'd by *Bartholinus* in the *Acta Hafniensia*) and quoted by an Ingenious *Fellow* of the *Royal Society* as credible. The *Title* of the *Experiment* being, to make two *Liquors* kindle one another tho' apart they are actually cold.

Tho' I knew it would fail of the desired event by several unsuccessful *Tryals* I had made, yet I was the willingier to make the *Experiment* before so many impartial Judges; because this specious *Experiment* had been imposed not only on some that were present, but also on the faith of many of the *German Nation*, who sometimes quoted it to serve their *Hypothesis*. This made it necessary to bring it to a final *Determination*.

### *Experiment IIII.*

BEING a Refutation of *Borrichius's* Experiment that pretends to Accension.

We took according to direction four Ounces of fresh drawn Spirit of *Venus Turpentine* to six Ounces of *Aquafortis* newly drawn and very strong.

We mixed them together in a Glass body, and accordingly placed the Vessel in the *Sun Beams*, (which I foretold some of the By-standers would deceive us) after half an hours Patience the *Liquors* began to ferment very furiously, in somuch that a very great Smoak was raised by this means which was ordered to kept down by a Cork that stopt the the Vessel. This condensed red Fume represented flame  
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by reason of the *Beams* of the *Sun* that were permitted to shine upon it : but I was assured that this was a great *Fallacy*, and that the Experiment contradicted the *Proverb*, *There is no Smoak without some Fire*. I was willing to give the *Experiment* any advantage, which made me comply with that Circumstance of doing it where the *Beams* of the *Sun* were admitted : but this very Circumstance giving ground to the mistake, I desired leave to make the *Experiment* in a dark Room where we should better discern any real productions of *Light* : being assured that the action of the *Liquors* would as certainly succeed in the *darken'd* Room as in a *light* One. The *Experiment* was repeated, and the action of the *Liquors* was no less vigorous than in the former *Experiment*. Moreover *Flax*, being lookt upon as a very combustible matter, was suspended in the *Fume* : but in short, the *Observers* of this *Experiment*, which were many and very *Inquisitive*, could not discover the least spark of *fire* or glimpe of *Light*, so that the *Flax* remain'd untouch'd, and the *fermenting Liquors* gave no *light*, *fire*, or *flame* : only take this Caution ; keep your *Candles* at a distance, for the *Fume* will soon take fire at any actual *flame* and set the *Liquors* a burning, and so it may impose upon the *Careless*.

#### *Experiment V.*

**B**Eing a New *Experiment* with Ebullition and incalcescence.

Amongst those various *mixtures*, wherein great Heats and Effervencies with much Ebullition were produced, none were so considerable as this, which was also shewn at the same *Meeting*.

Upon an Ounce of *spirit* of *Nitre*, if you pour two or three *Drams* gradually of the highest rectified *Spirit* of *Wine*, the Heat and Ebullition will be incredibly great.

And whereas in the former Experiment you must wait a good time for your *Effervescence*, here tis performed in an Instant, so that I had more reason to expect from the mighty action of these *Liquors* upon each other, a production of actual fire or flame, than from *Borrichius* his Experiment. Possibly some may be ready to imitate this Experiment which may fail them, unless they observe some little *Directions*. Errors of this kind, have made some people believe they are imposed upon when there is no such thing. Common *Spirit of Nitre*, such as was first distill'd into water, and afterwards *dephlegm'd* (or distill'd so as to have all the water separated) this will fail your expectations: it must be the *Red spirit of Nitre*, and a very high rectified Spirit of *Wine*. In the next place, you must first pour into your Glass the *spirit of Nitre*, which is the heavier *Liquor*, and then the *spirit of Wine* after, for if you invert the order you will have no Ebullition, which will not a little puzzle the reason of *Philosophers*.

In this Experiment (especially if the *Ingredients* are made very high) the *Spirit of Nitre* does as it were act the part of a *Coal of fire*: as *fire* exhales and drives up *water* that is thrown upon it, so does this *spirit of Nitre* very furiously throw up a great quantity of the *Vinous spirit*, in so much that it presently perfumes a Room with the smell: but to be more exact in this *Observation*, we mix'd equal parts together in a *Retort*, and then cemented a *Receiver* of good dimensions, and so we condens'd that *Vapor* which rises from this mixture and obtained much of our *Spirit of Wine* again.

Both these Experiments may serve as Arguments against the notion of *Acidum* and *Alkali*, since mighty *Conflicts* may be excited by bodies of differing *Textures* where these two *Principles* are not *conspicuous*. We have here indeed very strong *Acids*, but in the other never were any *Alkali's* suspected whether *volatile* or *fixt*. Nor can I think that latent *Alkali* imagined to be in the *spirit of Nitre* does produce

duce this great conflict, for I question whether there be any such thing; if it be an *Alkali*, it has quite lost its property, that is not wrought upon by so strong an *Acid* in whose bosom it lies. *Wood* may as well remain combustible in a great Fire, as such an *Alkali* under the power of so great an *Acid*. But this is only a hint.

There are various *Liquors* whose mixtures are apt to produce greater or lesser effervescencies, heats, and inflammations, so that particularly the great *Incalescence* and burnings in *Feavers* are easily accounted for, and made obvious by occurring *Experiments*. There seems more difficulty to account for some *cold disaffections* of the Blood, and other *Juices* of the body. For *Hysterical Persons* will complain of a great *Chilness* or *Frost* in the *Blood*, during that *Paroxysm*, such as a good fire and warm *Cordials* will not easily conquer. In these *Persons* the *Pulse* is always very tardy, (differing from what I have observed in *Agues* where in the *Cold Fit* it has been very quick.) This may be better explicated by a solution of *Sal Armoniack* than of *Nitre* in water.

### Experiment VI.

○ OF Cold produced without Ebullition, giving some account of Hysterical Paroxysms.

In about a Pint of water we dissolved a Quarter of a Pound of *Sal Armoniack*, which was found to be so very cold to the Touch that we needed no *Weather Glass* to convince us of the effect.

In this *Experiment* we have no Ebullition or swelling of the *Liquors*; but rather a *condensation*, which may also happen in the *Hysterical frigid Paroxysm*, for in case the humours swell'd they would require more space, which perhaps is not to be allow'd, but must then be compensated by the acceleration of the *Pulse*, which would then  
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be obliged to transmit the extended humours in a shorter time, but this is not our case here, but refers to the next. I here choose to explain the *affections* of the blood by the *solution* of *Sal Armoniack* that (as we said) in our *Experiment*) affected the *Blood* of those *Persons* that long touched it, with a sensible and troublesome degree of *cold*. For the *Mass* of *Blood* may be very apt to degenerate into such *Concretions* as do much resemble *Sal Armoniack*; and this will seem more probable if we consider that *humane* and *other* blood naturally abounds with *Urinous Salts*, and do preternaturally degenerate into Acrimonious and Pungent *Juices*, which may be much promoted by a too liberal use of high season'd or *salted Meat*, and *sour Liquors*. For this we find by *Experience* that such an *acid* as *Spirit of Salt* mixing with an *Urinous*, will be converted into *sal Armoniack* (which has now lost much of its *Volatile Nature*) This we may plainly discern by its *shooting into a Figure*, that resembles *Feathers*, which is proper to *Sal Armoniack*. That the blood does abound with various sorts of *Salt* 'tis not to be doubted, and that it has such a *Salt* as some call *Salsum*, which is *Sea-salt*, lately exhibited at the *Royal Society*, and lastly that *sal Armoniack* has its principal dependence on great quantities of *Volatile salt* (such as the *blood* is stored with) and on this mention'd *Salt*, 'tis very well known. So that having presupposed such *Concretions* as these to have their *existence* in the *blood*, we must consider how they come to act. That there may be some *antecedent* and other *Concomitant Causes* of *Hysterical Passions*, I do not deny; I only or principally consider the cause of the *cold affections*.

'Tis very probable that the *Glands* do suffer great *obstructions*, which are *antecedent* to this *Paroxysm*: I am the rather inclined to this opinion, by reason of so great a *Thirst* our *Patients* are apt to complain of before and in the *Fit*: by which *obstructions* the usual *Secretions* of the *Lympha* are hindered as well from watering the the *Mouth*

as the *Oesophagus* and *Stomack*, which causes *Thirst*. More over the less quantity of *Lympha* is evacuated the usual way, the more is absorbed by the *Veins*, which does so dilute those *Salts* in the *Mass* of blood as brings them to a *Fluor* or such a *solution* as is necessary to give the *cold Effect*. Thus *sal Armoniack* will mix with some *Liquors* and not with *others*, scarce at all with *Spirit of Wine*, and not so well with *Wine* as *Water*, and the more *limpid* the *Water* is, the better and sooner it *dissolves*, and to this *Menstruum* does especially impart this *cold Operation*. Which not unreasonable conjecture of an extraordinary effusion of *Lympha* into the *Mass* of Blood at such a time, is farther confirm'd by that great quantity of *Urine* those *Persons* are apt to make: which has made some fear a *Diabetes* that have not been well versed in such *Cases*: for the *Urine* here will look very *pale* and *limpid*. And this may be further proved that when the *Cuticular Glands* are hinder'd from doing their transpiring office, particularly by any cold ambient Fluid which happens to them that go into water, that then they are obliged to throw off greater quantities of *Urine*, which has been observed by me to be very *pale* and *insipid*, after a second or third *Evacuation*. But I must not be too tedious.

### Experiment VII.

OF Cold produced by a very great Ebullition wherein the cold and hot *Fits* of an *Ague* are resembled by a mixture of *Liquors*.

If we use in this *Experiment* any *Acid*, whether of *Vinegar*, *Verjuice*, *Wood Sorrel*, *Oranges*, *Limmons*, or perhaps yet milder ones, by casting into these *Juices* a *volatile Salt* of *Human Blood*, I always observed a notable *Ebullition* would ensue, which I never could find would heat as such boiling *Liquors* are apt to do (and one would expect

expect they should ) but on the contrary affected a good *Weather Glass* so as to make the *Liquor* descend, which was a manifest token of *Cold*. There I found that the higher the *Acid* was, the greater the *Ebullition* and the *Cold* would be, which is very remarkable. For this very Reason I made use of very strong *Vinegar*, dephlegm'd by *freezing* (which way is taught by the Honourable Mr. Boyle, to whose great favors and manuduction I must ascribe whatever service I shall be able to do *Experimental Philosophy*) by this *mixture* we came much nearer the *freezing* Point. But since it proves troublefom to prepare this *Vinegar*, and because it can be done only at *certain times*. I have most commonly made the *Experiment* with Spirit of *Venus*, or *Verdigrease*, which is the highest *Vinegar* in the world: with this the *Cold* will be most sensible to the *Touch*, and most conspicuous on the *Weather Glass*. For by this *mixture* I have in *Summer* made a *Weather Glass* to descend below the *Temperament* of cold Fountain water, *six Inches* at least, which brought it so near the *freezing* mark that it scarce wanted *half an Inch*. But at the same time the *Liquor* swells and takes up more room than before, and will not be contained in *shallow Vessels*. In this *Experiment* we have some things very rare, that a great and violent motion of two *dissenting Liquors*, should be so far from producing *Heat* as to produce a notable degree of *Cold*, and that too with a considerable expansion of their parts. Here we might instance in an apposite and as unexpected an *Experiment*, where an effect contrary to our common observation happens, and that is thus, if you mix with *Oyl of Vitriol* a quantity of *water*, a great *heat* will follow without an *Expansion* of these *Liquors*, whereas *heat* do's constantly produce it in *Wine*, *Water*, and most fluid and solid bodies; for here it rather shrinks and condenses, as you may see by making the *Experiment* in a *Glass* with a long *Neck*, and setting your *mark* as soon as you make your *mixture*. Both these *Instances* may a little puzzle the *Cartesian*

*tesian Hypothesis* to account for, tho I am far from thinking they are able to destroy them. But to proceed with our *Experiment*, after I had sufficiently satisfied the worthy *Spectators*, that the produced degree of *Cold* was very considerable, I then poured in some few drops of another *Liquor*, that soon alter'd the *temper* of our *Cold mixture* and in two or three *Minutes* brought it to a *warmth* beyond that of the *Ambient Air*, tho it was a very warm Sun-shining day, in *July*.

To apply the *Experiment*. In the *Cold Fit* of an *Ague* we have often a strong and quick Pulse, which argues an *Ebullition* (tho I dare not call it an *Effervescence*) and quick motion of the *Blood*, and the pains of the head and other parts may be due, to too great distress or extension of the Vessels, which depends on the expansion of the boyling humours. In this artificial tho *cold mixture* we observe, a mighty commotion and high *Ebullition* and expansion of the *Liquor*. In the *Blood* and other *Juices* of the body we constantly discover great quantities of *volatile Salts*, and sometimes either from an infected *Air*, or bad *diet*, and from several other causes, *sour Juices* may be derived to the *blood*, which may act upon these volatile Salts, the blood so much abounds with, as to give a notable sense of *cold*. It is no new thing for us to meet with *Patients*, that have thrown upon their *Stomacks* and *Bowels* (which are the great *Emunctories* of the *Blood*) very *sour Liquors*, such as when they happen to fall upon the *Teeth* will corrode those hard parts. Thus in our *Experiment* tis plain that a foreign *acid* meeting with a *volatile Salt* drawn from the *blood*, does produce a *cold effect*; and since we know no *Liquors* but a *mixture* of this kind that gives us such a *cold Phenomenon*, it seems not unreasonable to believe that the *cold Fit* of an *Ague* may be due to such a *mixture*.

As to the *Incalescence* made in our mixture, I should have told you that it was done by the bare addition of some drops of Oil of Sulphur *per Campanam*, being a *Liquor*

that owes its *Origine* to the *fire*, I suppose it to have borrowed that *Calorifrick* qualitie thence, which made it represent the *hot Fit* : for this I observed that notwithstanding the action of the *cold* mixture, it grew more thick and slimy than twas at first, and that the addition of the mention'd *Oil*, or *Spirit of Brimstone* made it more clear and fluid. Thus the agile Spirits of the humane body, which tho they cannot be thought to be actual *fire*, yet are supposed to be somewhat *Analogous* to it, being in more abundance poured into the turbid Mass of Blood, do by their warmth and action first attenuate those gross *Coagulums*, and then manifestly subdue, and reduce many of those indisposed Particles to a good *Texture*, and expel those that are disagreeable by *sweat* and *Urine* or both ways : which is a good *Prognostick* of a cure of that *Paroxysm*.

I shall only add this Objection made, *viz. That there are no such Acids of so high a degree of Acidity found in the human body as we make our Experiments with.*

I may answer that there is no need also of so great a degree of *Cold* to put our blood into an *Ague*, a small *declination* from its usual *Temperature*, being sufficient to make us very sensible.

Postscript

## Postscript.

I shall here only hint by way of *Postscript* an ingenious *Proposition* of a very worthy *Person* of the *Society*, to try whether the *Cortex Peruvianus* would not prevent this *Artificial Ague* our *Liquors* produced : which we brought to Tryal, tho the success did not answer. For we made a strong Infusion of our *Bark* in common *Vinegar* and then injected a quantity of the mention'd *volatile Salt*, a considerable *Commotion* of the *Liquor* ensued with a degree of *Cold*, but was not altogether so fierce as formerly, moreover it abated much of rising to the heighth of the former Experiment, when *Opium* was mixt with the mention'd *Cortex* : tho in this case the *Acidity* was far from being quite mortified. As to the *Cortex* I do not intend in this *Experiment* to explain its *Nature*, which was only made to satisfy that sagacious *Gentleman's* Curiosity : for I never thought that *sebrifuge* did act the part of an *Alkali* in performing the *Cure*. But if I can make it appear that there are other *Medicines* that do pertain or belong to the families of *Alkaly's*, which are effectual in the cure of *Agues*, this may serve to prove, that they do it by destroying some morbid *Acidities* in the humours or *Viscera*, and so prevent the usual *Commotions* such disagreeable *Liquids* are apt to make upon their *Conventions*. This is manifest that *Coral* and *Crabs eys* and other *Testaceous* bodies number'd amongst the fixt *Alcaly's* and not only these but those real fixt salts, as *Sal Absinthij*, *Cardui benedicti* &c. as well as the *volatile Salts* in general, do highly correct and change *Acid humours* where they can meet them, and not only so but do hinder *Liquors* that are apt to sour and corrupt from degenerating : (thus Milk and Blood it self may be preserved much longer ; the first from growing sour, the last

from fermenting and putrifying by a quantity of *volatile Salt* or *Spirit* mixt with them :) which is in like manner granted to be true, that many *Agues* have been cured by *Medicines* of this Nature. *Sal Absinthij* as well as *volatile Salts* are used as the principal *Ingredients* in common *Febri-  
fuges*. For a farther prosecution of this *Experiment*, we dissolved as much *Chalk* as strong *Vinegar* was able to do, and then having strained it through a *Filter*, we poured it upon a quantity of the highly rectified *Spirit of Blood*, but found neither *Ebullition*, or any sensation of cold or heat to follow.

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The